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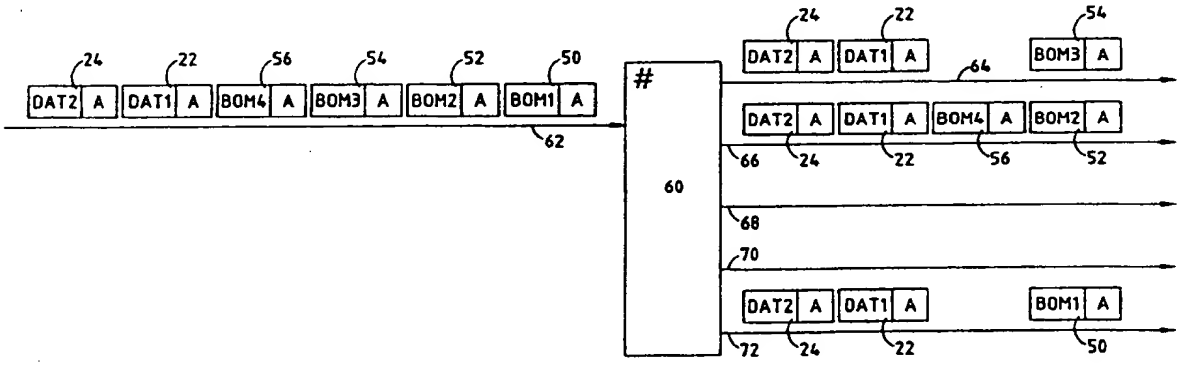
(54) Title: MULTICASTING METHOD FOR A TELECOMMUNICATIONS NETWORK



(57) Abstract

A multicasting method for a telecommunications network which is adapted to transmit information in segments (20, 22, 24) of data (10). The method involves generating and transmitting segments (22, 24) of data (10) to be multicast with the segments including common message identification data (32) and routing the segments (22, 24) through the network using at least one switching station (60) which outputs the segments (22, 24) to a plurality of output ports (64, 66, 62, 72) of the station (60) on the basis of the message identification data (32). Beginning segments (50, 52, 54, 56) are generated which have respective destination addresses, the message identification data (32) and the common part of the information to be transmitted. The beginning segments (50, 52, 54, 56) are transmitted through the network on the basis of the destination addresses to the destinations corresponding thereto and routes are established through the network to the destinations on the basis of the message identification data (32). The remainder of the information is transmitted on at least one remainder segment (22, 24) which includes the message identification data (32). The remainder segments (22, 24) are routed through the network to the destinations on the basis of the message identification data (32). A switching station (60) is provided which is adapted to process the beginning segments (50, 52, 54, 56) as they are routed through the network and establish routing data for storage therein, which is used to direct the remainder segments (22, 24) to output ports (64, 66, 72) of the station (60) on the basis of the message identification data.

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MULTICASTING METHOD FOR A TELECOMMUNICATIONS NETWORK

The present invention relates to a multicasting method for a telecommunications network which is adapted to transmit information in segments of data.

Multicasting is the process of distributing information from a single source to a number of destinations over a telecommunications network. There is a desire for multicasting capabilities to be provided on Metropolitan Area Networks (MAN) and on the broadband ISDN. Multicasting on networks can be used for electric publication, software distribution and Local Area Network bridging.

At present broadcasting and replication are two methods which are used to achieve multicasting. Broadcasting involves assigning a group address to all of the intended destinations. The information to be transmitted is then broadcast to all stations on all sub-networks of the network and the intended destinations selectively receive the broadcast information on the basis of the group address transmitted with the information. If only a small subset of stations are intended to receive the broadcast, then this method represents a significant wastage of the transmission resources of the network.

Replication involves replicating or copying packets at the source of the information and transmitting each packet, in a normal manner to a respective one of the intended destinations. Although this method is relatively simple to manage, it is inefficient in its use of transmission resources, particularly when the number of intended destinations is large.

In accordance with the present invention there is provided a multicasting method for a telecommunications network which is adapted to transmit information in segments of data, said method comprising:

generating and transmitting segments of data to be multicast, said segments including common message identification data;

routing said segments through said network using at least one switching station which outputs said segments to a plurality of output ports of said station on the basis of said message identification data.

Preferably said at least one switching station includes stored routing data which maps said message identification data to said plurality of output ports, and said segments received by said station which include said message identification are outputted on said output ports in accordance with said routing data.

Preferably said method includes generating and transmitting a plurality of beginning segments which include respective destination addresses and said message identification data, and establishing said routing data on the basis of said beginning segments as said beginning segments are respectively routed through said switching station to respective ones of said output ports on the basis of said destination addresses.

The present invention provides a multicasting method for a telecommunications network which is adapted to transmit information in segments of data, said method comprising:

generating and transmitting a plurality of beginning segments for and to desired destinations of said information, said beginning segments including respective destination addresses, common message identification data and a common part of said information;

establishing routes through said network to said destinations on the basis of said message identification data; and

transmitting the remainder of said information on at least one remainder segment which includes said message identification data, said remainder segment being routed through said network to said destinations on the basis of said message identification data.

Preferably said beginning segments establish said routes as they are transmitted through said network.

Preferably the remainder of said information is transmitted on a plurality of continuation segments and an end segment, which each include a respective part of said information.

The present invention also provides a multicasting method for a telecommunications network which is adapted to transmit a datagram in segments of data, said segments including a beginning segment, at least one continuation segment and an end segment, each including a respective part of the information to be transmitted by said datagram and common message identification data, said method comprising:

replicating said beginning segment to generate a plurality of beginning segments which include said message identification data, a common part of said information, and different destination addresses,

transmitting said plurality of beginning segments through said network on the basis of said destination addresses to respective destinations corresponding thereto and establishing routing data at switching stations of said network which maps said message identification data to output ports of said stations, and

transmitting said at least one continuation segment and said end segment through said network to said destinations on the basis of the message identification data included therein and said routing data.

The present invention further provides a switching station for a telecommunications network which is adapted to transmit information in segments of data, beginning segments being used to transmit part of said information and including respective destination addresses and common message identification data when said information is to be multicast, the remainder of said information being transmitted on at least one remainder segment which includes said message identification data, said station comprising an input port for receiving said segments, a plurality of output

ports, and means for processing and transmitting said beginning segments to respective ones of said output ports on the basis of said destination addresses and establishing and storing routing data therein on the basis of said message identification data, and for transmitting said at least one remainder segment, on being received by said switch, on the basis of said message identification data to all of the output ports which received said beginning segments.

Preferably said routing data is stored as a routing table which maps message identification data to output ports after said beginning segments have been received and processed.

The method and station described above are particularly advantageous for use in networks which employ the DQDB (Distributed Queue Dual Bus) protocol which is described in the report of the IEEE 802.6 Working Group Entitled "Proposed IEEE Standard 802.6 – Distributed Queue Dual Bus (DQDB) Metropolitan Area Network (MAN)", Draft D10, May 1989 and the specification of International Application PCT/AU85/00304 (International Publication WO 86/03639) which are herein incorporated by reference. The method and station are, however, suitable for use in any network which is able to employ segmented datagrams, or packets. The method uses bandwidth efficiently and does not require additional routing information. The approach adopted by the multicasting method described above is less expensive to implement than the replication method for any number of destinations. The broadcast method is also more expensive to implement than the method of the present invention and the costs only become comparable for large numbers of destinations.

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings wherein:

Figure 1 is a diagram of the format of a datagram;

Figure 2 is a diagram of a segmented datagram;

Figure 3 is a diagram of the format of a segment of a datagram;

Figure 4 is a diagram of a preferred multicasting arrangement in a network;

Figure 5 is a diagram of a datagram which has been segmented according to the method of the present invention;

Figure 6 is a diagram of a preferred embodiment of a switch, or station, according to the present invention; and

Figure 7 is a diagram illustrating use of the method of the present invention in a network which employs the DQDB protocol.

According to the standard which has been adopted by the IEEE 802.6 Working Group, a connectionless packet, or datagram 10, as illustrated in Figure 1, includes a number of fields 12 which are designated for containing specific data. The header 14 of the datagram includes transmission information such as a destination address 16 and a source address 18. In segmenting telecommunications networks, a datagram 10, as shown in Figure 2, is segmented into a number of segments 20, 22 and 24. The segments include a beginning of message (BOM) segment 20, a plurality of continuation of message (COM) segments 22 and an end of message (EOM) segment 24. The segments 20, 22 and 24 each include a 5 octet header 26 and a payload field 28 of 48 octets, as shown in Figure 3, which includes part of the information which is to be transmitted by the datagram. The segments 20, 22 and 24 further include a segment type field 30, which indicates whether the segment is a BOM, COM or EOM segment, and a message identifier (MID) field 32. The BOM, COM and EOM segments 20, 22 and 24 of a datagram 10 are identified as belonging to the datagram 10 by including a common message identifier in their respective MID fields 32. The segments 20, 22 and 24 are each used to transmit a respective part of the information to be transmitted by the datagram 10.

To perform efficient multicasting over a large network, distribution or "splitting" of the information to be multicast should be carried out by each station along the routes to the desired destinations. For example, in a network 34, as shown in Figure 4, where information from a source terminal 36 is to be multicast to three groups of destinations 38, the information is first split at a station, or switch, 40 to three output lines for each group. The information is transmitted via the output lines

to respective stations or switches 42 of each group. The stations 42 further split the information received so as to transmit the information to the desired destinations 38 connected thereto.

The present invention has been developed with the above principle in mind and preferred embodiments of the method and station of the present invention are hereinafter described.

A multicasting method according to the present invention involves replicating the BOM segment of a datagram 10 to be multicast, as shown in Figure 5, into a plurality of BOM segments 50, 52, 54 and 56, one for each destination of the information, before transmitting the datagram. The segments 50, 52, 54 and 56 each include a respective unicast destination address (UDA) and would not be distinguishable from a unicast BOM segment 20, except the replicated BOM segments 50 each include the same MID. The COM and EOM segments 22 and 24 of the datagram 10 remain the same and are not replicated for each destination. A datagram 10 to be multicast has a multicast destination address (MDA).

The datagram 10 is transmitted and multicast by the stations, or switches, 60 of the network, as shown in Figure 6. Four switch structures which could be employed to implement the stations 60 are described in a paper by Andrew R Jacob entitled "A Survey of Fast Packet Switches", Computer Communications Review, Vol 20 No 1 January 1990, herein incorporated by reference. The stations 60 each include processing circuitry and data storage circuitry and on receiving the plurality of BOM segments 50, 52, 54 and 56 on an input line 62 process the destination addresses in the segments 50, 52, 54 and 56. A station 60 directs the BOM segments 50, 52, 54 and 56 to the appropriate output port 64, 66, 68, 70 or 72 of the station 60 depending on the destination indicated by the destination address of each segment. For instance, in the example illustrated in Figure 6, the first BOM segment 50 is outputted on the fifth output port 72, the third BOM segment 54 is outputted on the first output port 64 and the second and fourth BOM segments 52 and 56 are outputted on the second

output port 66.

The station 60 in processing the BOM segments 50, 52, 54 and 56 extracts the MID from each segment and establishes and stores routing information which maps the MID to the output port to which the respective BOM segment has been transmitted. The routing information is stored in the data storage circuitry of the switch 60 as a routing table.

As the BOM segments 50, 52, 54 and 56 all have the same MID, the routing table maps the MID to each of the output ports which received the BOM segments 50, 52, 54 and 56. COM and EOM segments 20, 22 and 24 which are received thereafter by the stations 60 are routed to respective output ports 64, 66, 68, 70 or 72 on the basis of the MID contained in the segments 22 and 24. Hence, if an MID is mapped, or allocated, to more than one output port of a station 60, COM and EOM segments 22 and 24 received by the station 60 and which include the MID are multicast to each one of the allocated output ports. The method thereby effectively employs the principle described previously with reference to Figure 4.

With reference to the example illustrated in Figure 6, the remainder of the information of the datagram 10 not included in each BOM segment 50, 52, 54 and 56 is transmitted in a COM segment 22 and an EOM segment 24. On the basis of the routing table established after processing of the BOM segments 50, 52, 54 and 56, the segments 22 and 24 are transmitted to the first port 64, the second port 66 and the fifth port 72. The segments 22 and 24 transmitted to the output port 66 will be multicast again at a later stage by another station 60 when the second and fourth BOM segments 52 and 56 are transmitted to different output ports.

The routing tables in the station 60 of the network may be established, as described previously, when the BOM segments are processed or the tables may be established by a network managing circuit when the BOM segments are replicated, as shown in Figure 5.

The multicasting method described above is suitable for implementation in a QPSX network 100 which employs the DQDB protocol. An example is illustrated in Figure 7 where a first datagram including segments having an MID 1 is multicast to two stations 102 and 104 from a sending station 106. A second datagram including segments having an MID 2 is transmitted to the second receiving station 104 and a third datagram including segments having an MID 3 is transmitted to the first receiving station 102 by the sending station 106. The sending station 106 is placed between the two receiving stations 102 and 104 and each station is connected to the two buses 108 and 110, which transmit slots, or segments, in opposite directions.

When segments of a datagram are to be transmitted by the sending station 106, a routing table 112 is updated, on the basis of the destination address of the datagram to map the MID of the segments of the datagram to a desired bus 108 or 110 for transmission. In the case of the first datagram, the MID 1 is mapped to both buses 108 and 110, for the second datagram the MID 2 is mapped to the first bus 108 and for the third datagram the MID 3 is mapped to the second bus 110. The BOM segment of the first datagram is replicated and the replicated segments include respective destination addresses and are placed on the corresponding bus 108 or 110.

On receiving BOM segments, the receiving stations 102 and 104 process the unicast destination address included in the BOM segments and update respective receiving tables 114 and 116 which map the MID's of the segments to a receive flag. The receive flag determines whether the receiving station 102 or 104 is to receive or accept segments with the corresponding MID. Therefore, the routing table 114 for the first receiving station 102 has receive flags set to "yes" for only MID's 1 and 3 and the routing table 116 of the second receiving 104 has receive flags set to "yes" for the MID's 1 and 2 only. With routing tables 112, 114 and 116 established as shown in Figure 7, segments with the MID 1 are placed on both buses 108 and 110 and multicast to both receiving stations 102 and 104, whereas segments with MID's 2 and 3 are transmitted and received by the third and second receiving stations 104 and 102, respectively.

Existing segmenting telecommunications networks can be, in most cases, reconfigured to perform the multicasting method of the present invention by altering the software in the switching stations so as to produce and handle the replicated BOM segments and establish and use the necessary routing tables for the remaining segments.

CLAIMS:

1. A multicasting method for a telecommunications network which is adapted to transmit information in segments (20, 22, 24) of data (10), said method comprising

generating and transmitting segments (22, 24) of data (10) to be multicast, said segments including common message identification data (32);

routing said segments (22, 24) through said network using at least one switching station (60) which outputs said segments (22, 24) to a plurality of output ports (64, 66, 72) of said station (60) on the basis of said message identification data (32).

2. A multicasting method as claimed in claim 1, wherein said at least one switching station (60) includes stored routing data which maps said message identification data to said plurality of output ports (64, 66, 72), and said segments (22, 24) received by said station (60) which include said message identification data are outputted on said output ports (64, 66, 72) in accordance with said routing data.

3. A multicasting method as claimed in claim 2, including generating and transmitting a plurality of beginning segments (50, 52, 54, 56) which include respective destination addresses and said message identification data (32), and establishing said routing data on the basis of said beginning segments (50, 52, 54, 56) as said beginning segments (50, 52, 54, 56) are respectively routed through said switching station (60) to respective ones of said output ports (64, 66, 72) on the basis of said destination addresses.

4. A multicasting method for a telecommunications network which is adapted to transmit information in segments (20, 22, 24) of data (10), said method comprising:

generating and transmitting a plurality of beginning segments (50, 52, 54, 56) for and to desired destinations of said information, said beginning segments including respective destination addresses, common message identification data (32) and a common part of said information;

establishing routes through said network to said destinations on the basis of said message identification data (32); and

transmitting the remainder of said information on at least one remainder segment (22, 24) which includes said message identification data (32), said remainder segment being routed through said network to said destinations on the basis of said message identification data (32).

5. A multicasting method as claimed in claim 4, wherein said beginning segments (50, 52, 54, 56) establish said routes as they are transmitted through said network.

6. A multicasting method as claimed in claim 5, wherein said routes are established by establishing routing data in switching stations (60) of said network as said beginning segments (50, 52, 54, 56) are routed through said stations (60) on the basis of said destination addresses, and said routing data maps message identification data (32) of incoming segments to the output ports (64, 66, 72) of said stations (60).

7. A multicasting method as claimed in claim 5 or 6, wherein the remainder of said information is transmitted on a plurality of continuation segments (22) and an end segment (24), which each include a respective part of said information.

8. A multicasting method for a telecommunications network which is adapted to transmit a datagram (10) in segments (20, 22, 24) of data, said segments (20, 22, 24) including a beginning segment (20), at least one continuation segment (22) and an end segment (24), each including a respective part of the information to be transmitted by said datagram (10) and common message identification data (32), said method comprising:

replicating said beginning segment (20) to generate a plurality of beginning segments (50, 52, 54, 56) which include said message identification data (32), a common part of said information, and different destination addresses,

transmitting said plurality of beginning segments through said network on the basis of said destination addresses to respective destinations corresponding thereto and

establishing routing data at switching stations (60) of said network which maps said message identification data (32) to output ports (64, 66, 72) of said stations (60), and

transmitting said at least one continuation segment (22) and said end segment (24) through said network to said destinations on the basis of the message identification data (32) included therein and said routing data.

9. A switching station (60) for a telecommunications network which is adapted to transmit information in segments (20, 22, 24) of data, beginning segments (50, 52, 54, 56) being used to transmit part of said information and including respective destination addresses and common message identification data (32) when said information is to be multicast, the remainder of said information being transmitted on at least one remainder segment (22, 24) which includes said message identification data (32), said station (60) comprising an input port (62) for receiving said segments, a plurality of output ports (64, 66, 68, 70, 72), and means for processing and transmitting said beginning segments (50, 52, 54, 56) to respective ones (64, 66, 72) of said output ports (64, 66, 68, 70, 72) on the basis of said destination addresses and establishing and storing routing data therein on the basis of said message identification data (32), and for transmitting said at least one remainder segment (22, 24), on being received by said switch (60), on the basis of said message identification data (32) to all of the output ports (64, 66, 72) which received said beginning segments (50, 52, 54, 56).

10. A switching station as claimed in claim 9, wherein said routing data is stored as a routing table (112) which maps message identification data (32) to output ports (64, 66, 72) after said beginning segments (50, 52, 54, 56) have been received and processed.

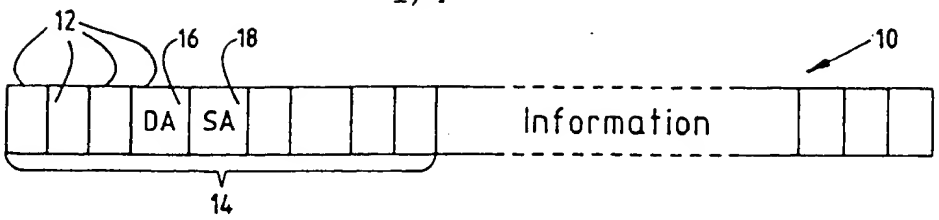

FIG 1

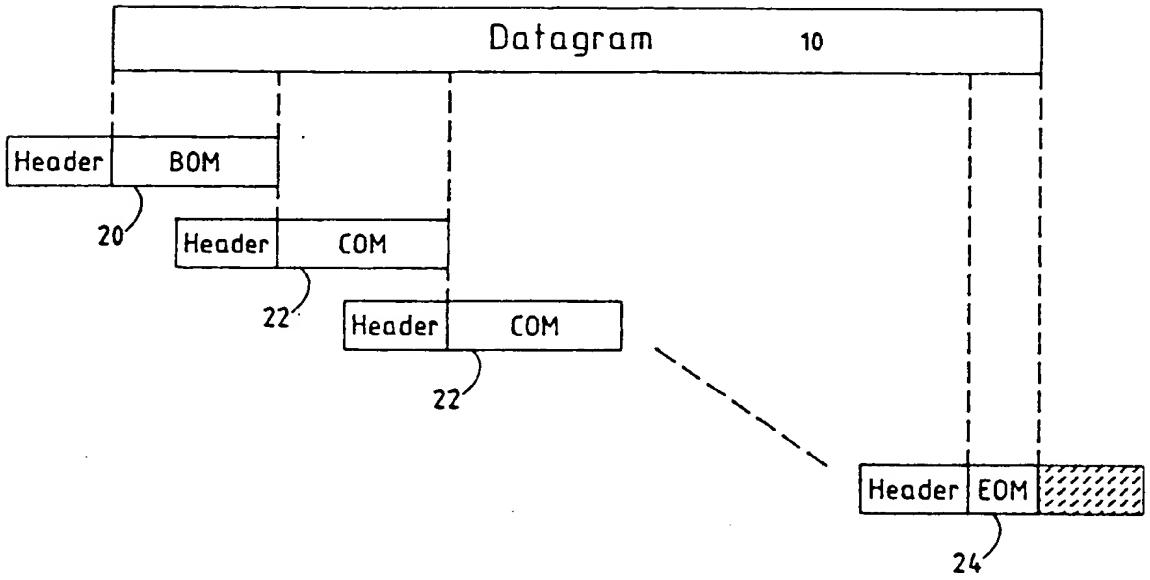

FIG 2

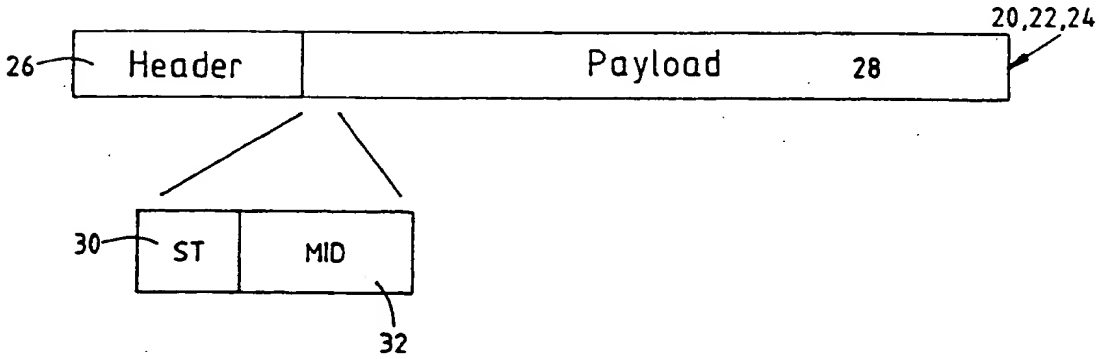

FIG 3

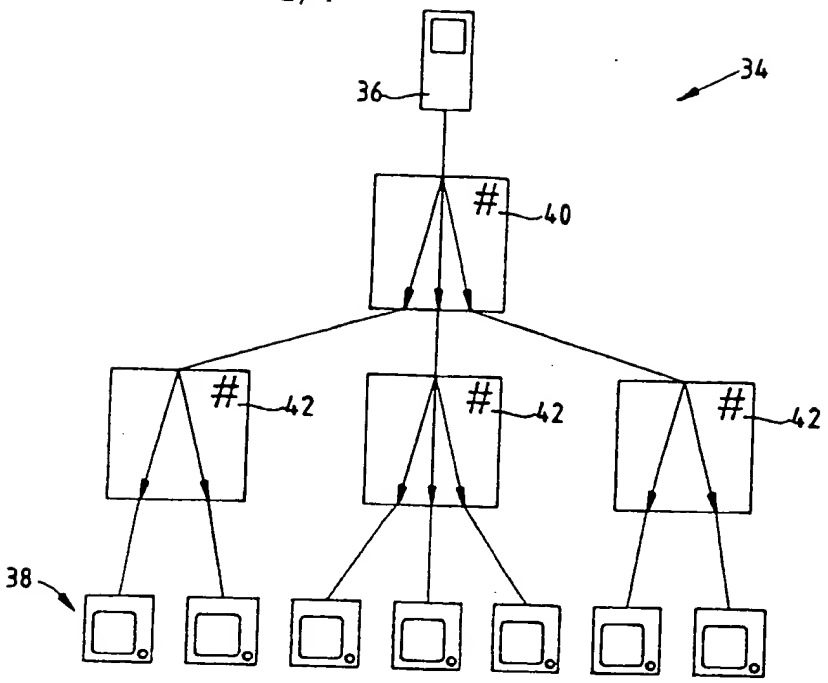

FIG 4

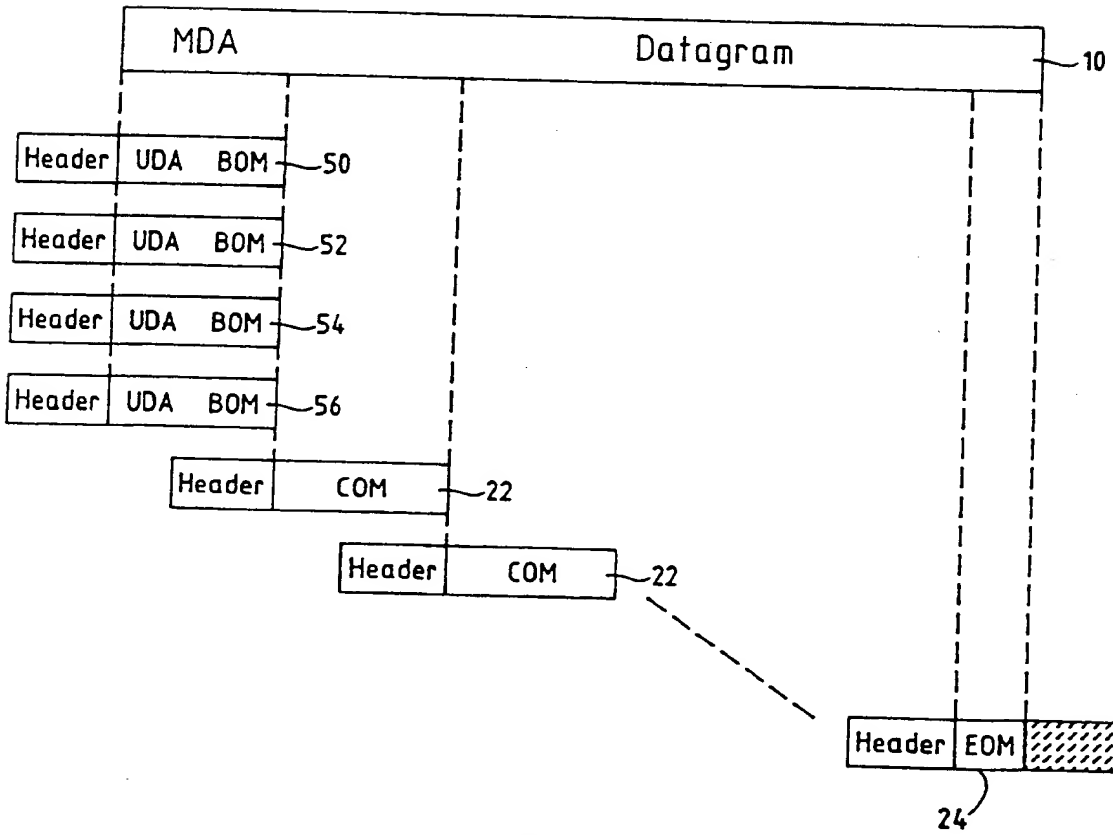

FIG 5

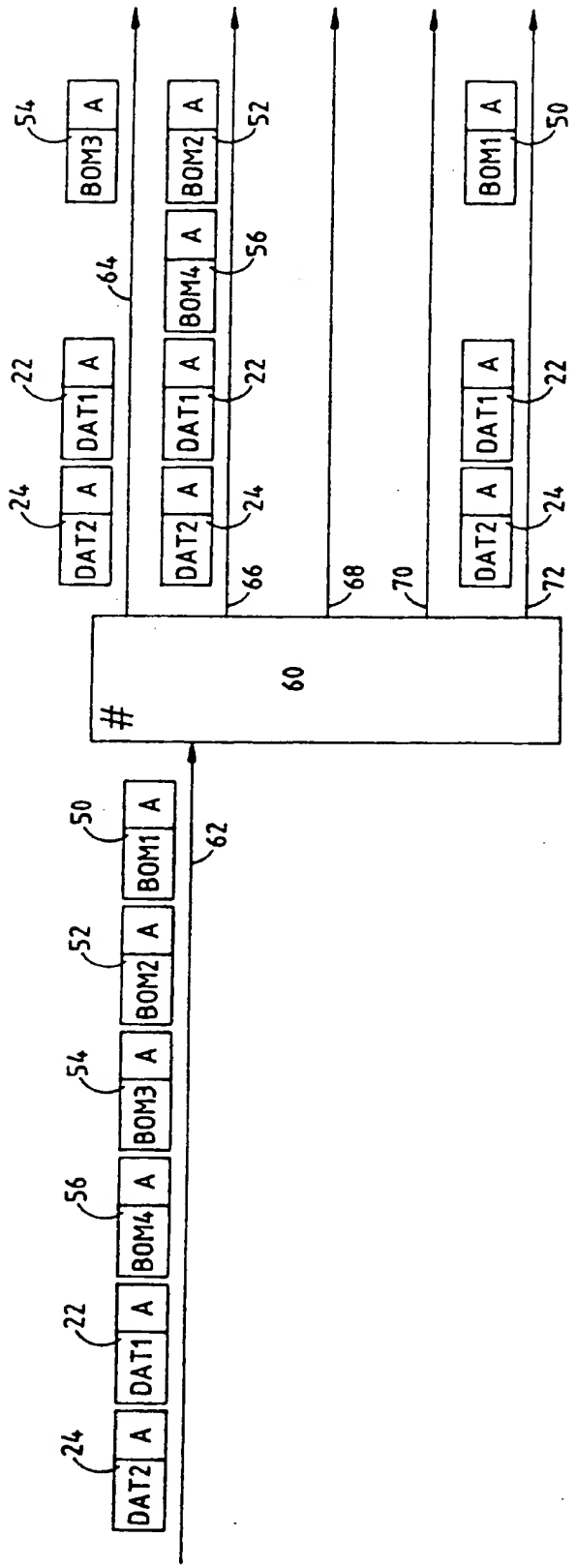
#
60
62
50
52
54
56
22
24
64
66
68
70
72
BOM1
BOM2
BOM3
BOM4
DAT1
DAT2
A

FIG 6

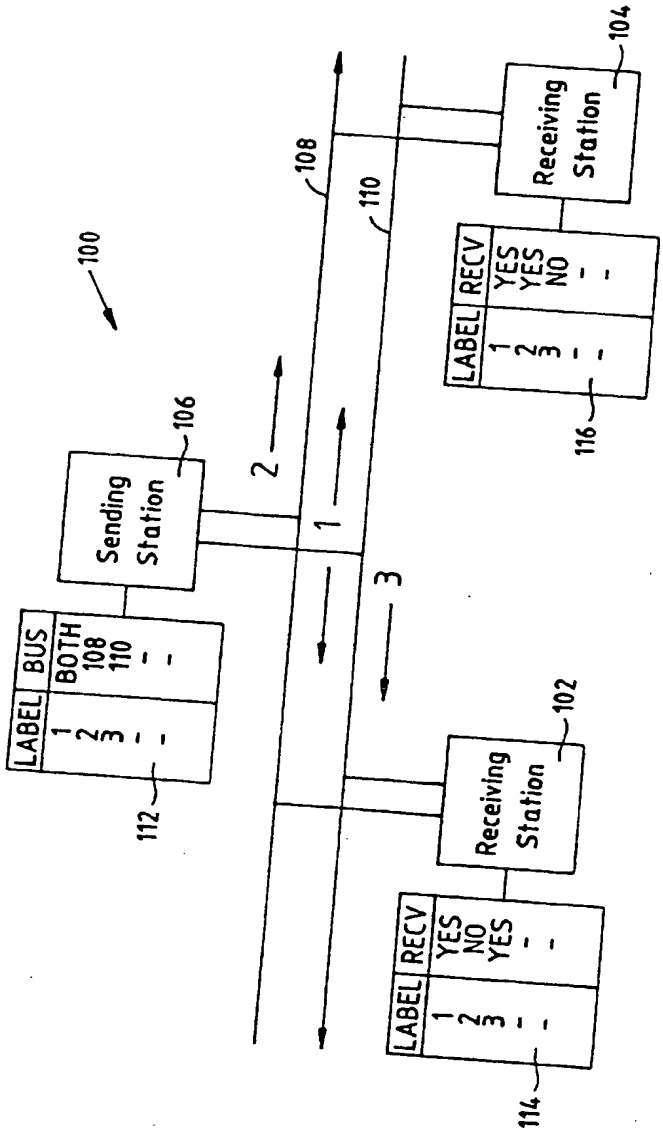

FIG 7

INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 91/00111

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[5] H04L 12/56; H04L 12/18

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC	H04L 11/18, 11/20, 12/18, 12/56

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, [11] with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
P,X	WO,A, 90/05419 (BUDRIKIS et al) 17 May 1990 (17.05.90) See page 2 line 25 - page 5 line 36.	(1)
Y	AU,A, 12628/88 (ALCATEL N.V.) 22 September 1988 (22.09.88) See claim 1.	(1)
Y	AU,A, 26685/88 (ALCATEL N.V.) 22 June 1989 (22.06.89) See page 3 line 26 - page 4 line 14.	(1)
Y	AU,A, 26526/88 (ALCATEL N.V.) 22 June 1989 (22.06.89) See page 2 line 21 - page 3 line 13.	(1)
Y	WO,A, 88/07293 (CANTONI et al) 22 September 1988 (22.09.88) See page 5 lines 3-15.	(1)

(continued)

* Special categories of cited documents: 10

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
3 June 1991 (03.06.91)	7 June 1991
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	a.W. Duke A.W. DUKE

Form PCT/ISA/210 (second sheet) (January 1985)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	AU,A, 66861/86 (INTERNATIONAL STANDARD ELECTRIC CORPORATION) See page 2 lines 18-29.	(1)
Y	US,A, 4577308 (LARSON et al) 18 March 1986 (18.03.86) See column 11 lines 25-33.	(1)
Y	US,A, 4603416 (SERVEL et al) 29 July 1986 (29.07.86) See abstract.	(1)
Y	WO,A, 86/02512 (HUGHES AIRCRAFT COMPANY) 24 April 1986 (24.04.86) See page 3 line 34 - page 4 line 14.	(1)
Y	WO,A, 87/00372 (AMERICAN TELEPHONE & TELEGRAPH COMPANY) 15 January 1987 (15.01.87) See page 3 lines 16-24.	(1)

V. [ ] OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE 1

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.[ ] Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:

2.[ ] Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.[ ] Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4 (a):

VI. [ ] OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING 2

This International Searching Authority found multiple inventions in this international application as follows:

1.[ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2.[ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3.[ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. [ ] As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

[ ] The additional search fees were accompanied by applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL APPLICATION NO. PCT/AU 91/00111

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
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END OF ANNEX